Extravehicular Activity (EVA) Tools

Mary Walker
EVA Tools Project Manager

EVA Tools and Equipment

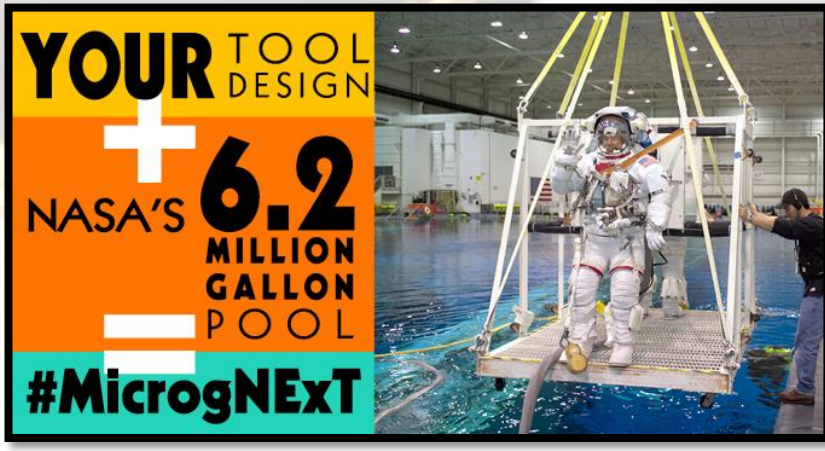
- The team is comprised of employees at NASA JSC working in the Tools, Equipment and Habitability Systems Branch of the Crew and Thermal Systems Division.
- The team houses Project Managers, Project Engineers, and ISS EVA Tools System Management that develop Flight Hardware for ISS and lead early development of Exploration focused tools.
- Exploration EVA Tool Development
  - The goal is to use a lean funding model to develop and test hardware in support of Operations Concept formulation at the program level AND becoming “smart buyers” for future Flight Hardware development.
  - Hardware development guided by EVA System Maturation Team (SMT) Gap List
  - Methodology:
    - Rapid development cycles
    - Focus on functionality
    - Low cost solutions

Flight Hardware

- EC7 houses project managers with experience developing and certifying Flight hardware.
- Previous projects:
  - Articulating Portable Foot Restraint (APFR)
  - Body Restraint Tether (BRT)
  - Contingency Operations LAPA Tool (COLT)
- Recent projects:
  - EVA GoPro
  - Dual Tether Points
  - EVA Inspection Mirror
  - EVA Cap Keeper
- Current projects:
  - Alpha Magnetic Spectrometer (AMS) Repair Tools

Recent Exploration Tool Work

- Micro-G NExT
  - The Micro-G Neutral Buoyancy Experiment Design Teams (Micro-G NExT) Program challenges undergraduate students to propose, design, build, and test a tool that addresses an authentic, current space exploration problem.
- Z2 Tool Integration
  - Supporting development of prototype spacesuits.
  - Specifically figuring out methods for integrating tools onto the suit.
- NEEMO 22 Mission
- Integrated Geology Sampling System



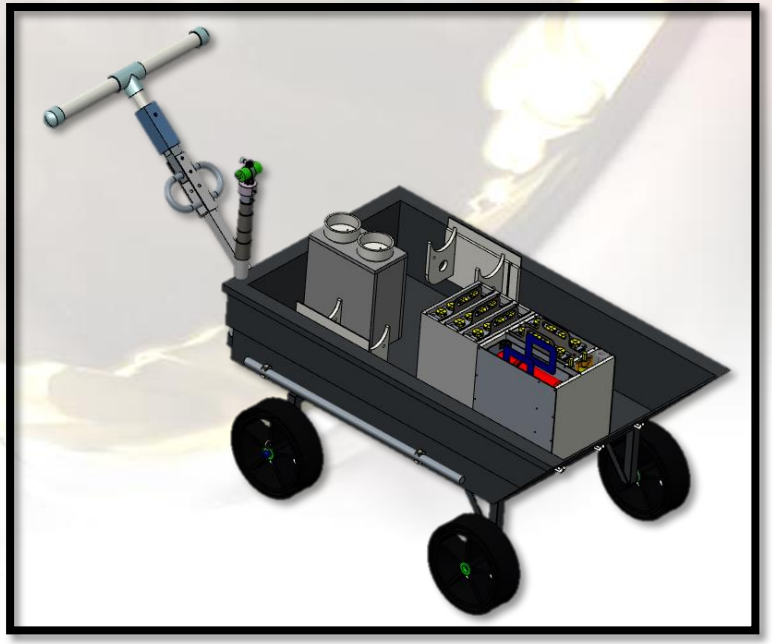
Integrated Geology Sampling System

- In support of the Asteroid Redirect Mission, the team developed an *integrated* sampling kit that focused on sample containment and a cross-contamination protocol.
- This prototype was tested in various environments and took in account more stringent contamination requirements than existed during Apollo.

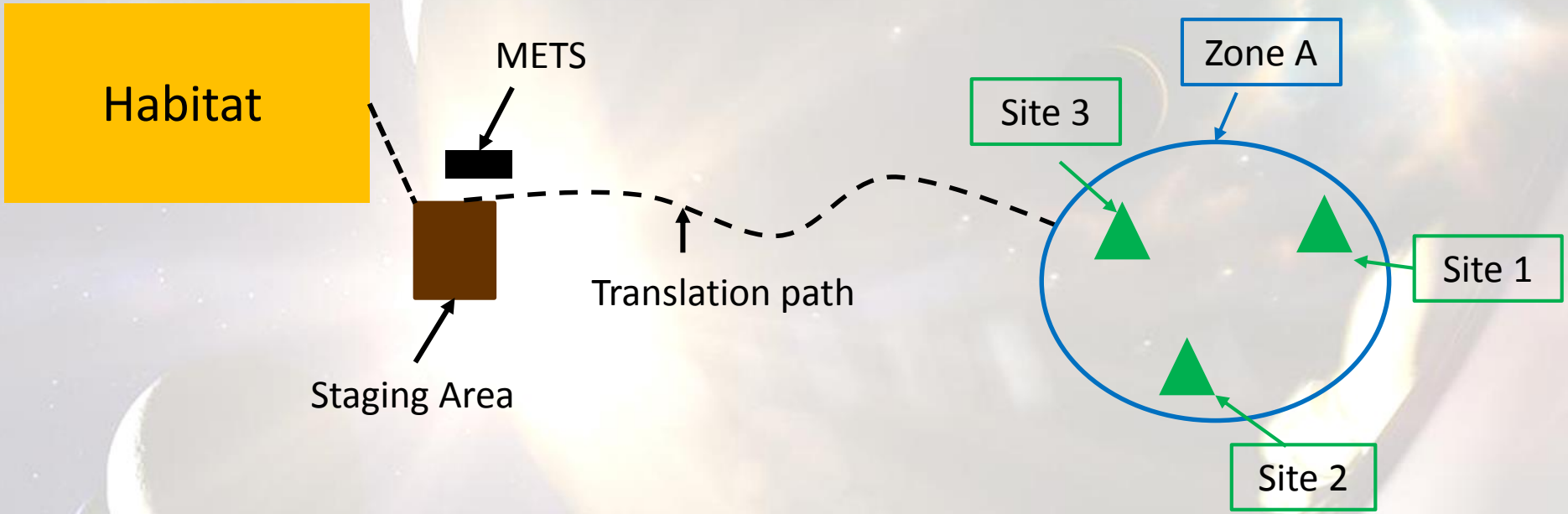
- Sample Briefcase
  - The **Sample Briefcase** is the carrying case in which the end effectors are housed prior to and after use.
  - Serves as a method to transport end effectors to and from worksites and provides final containment once a sample is collected.
- Drivers
  - **Manual Driver** is used to obtain loosely adhered samples that can be liberated using hand strength alone.
  - **Powered Driver** is used when an increased force is needed to remove samples from the surface.

Surface Exploration Work

- During the NEEMO 22 mission, the team tested a new method for transporting equipment across a planetary surface.
- The Modular Equipment Transport System (METS) is a method for transporting equipment using an understanding of the planned EVA tasks to intelligently group hardware into Modules.
- The METS was also outfitted with other features to support EVAs such as: situational awareness camera, Navigation Mount, flexible mount for procedure viewer.
- The benefits of this method are:
  - Provide increased efficiency for crew translation (minimize back and forth trips to retrieve and return tools).
  - Minimize crew exertion.
  - Enable the crew to get tools into locations that are unreachable by their larger caddy.



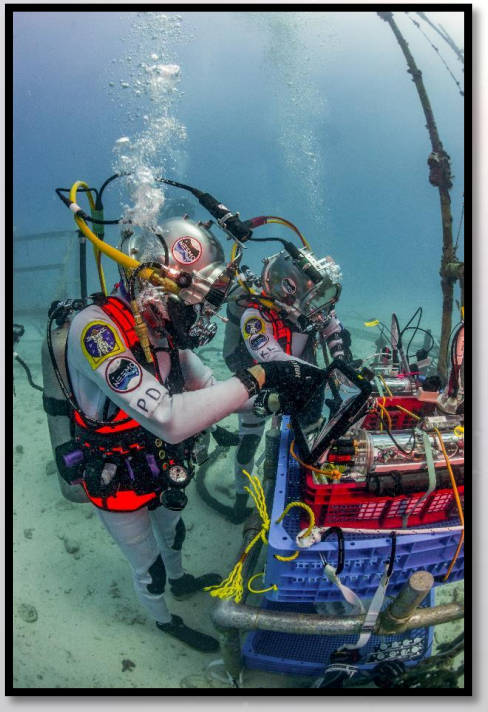
Operations Overview



Exit Habitat Head to Staging Area → Retrieve Modules needed for the day's operations and place in METS → Translate with METS to Zone of interest → Place METS at edge of Zone → Remove the Modules needed for the Task, head for Site → Arrive at the Site and perform Task → Return to METS and replace the Modules

Lessons Learned

- In order for this concept to work, every piece of hardware involved in EVAs needs to be accounted for in order to develop the modules appropriately.
  - Development process needs to be closely integrated.
- Crew comment: It was nice to be able to park the METS in one location and only carry what was needed to the different sampling sites.
- Has potential to be over-constraining. But should be evaluated further moving forward.



Future Work

- The team is closely integrated with colleagues across the Agency and Industry working on Exploration EVAs.
  - XX Exploration EVA Management
  - XI Astromaterials Research and Exploration Science
  - XM Exploration Mission Planning
  - Honeybee Robotics
- Continue working to close gaps on the SMT Gap List.
- Top areas of focus moving forward:
  - Crew operated core drills
  - Surface tool transportation
  - Handheld, portable geology instruments space-ification
  - Incapacitated crew rescue
  - Support science and operations colleagues in various testing